PATENT SPECIFICATION

Application Date: April 26, 1940. No. 7551/40. 540,027

Complete Specification Left: April 17, 1941.

Complete Specification Accepted: Oct. 2, 1941.

PROVISIONAL SPECIFICATION

Improvements in and relating to Rock Boring and like Tools

I, PERCY COX, a British subject, of Old Bridleway, Forest Drive, Keston Park, Kent, do hereby declare the nature of this invention to be as follows:—

This invention relates to rock boring and like tools and is particularly concerned with a tool adapted for the counterboring of previously drilled holes in rock and similar formations either natural or artificial. In rock blasting operations the size of the explosive charge is limited by the diameter of the shot hole which should be small, otherwise not only is the cost of drilling excessive but the efficacy of the charge will be reduced. The normal size of shot hole is from one and a half to three inches in diameter. Attempts have been made to enlarge the inner end of the shot holes for accommodating bigger charges but hitherto no satisfactory way of accomplishing this has been evolved. The present invention aims to provide a simple and effective means for enlarging or counterboring drilled holes in rock formations and particularly to enable the inner ends of shot holes to be enlarged for the purpose described above. Another object of the invention is to provide a tool for this purpose which is of simple and rugged construction, and one which is adapted to be operated by the apparatus usually available for rock drilling.

According to the invention a counterboring tool is provided comprising a body which may be introduced into the hole and rotated therein, having cutters movably mounted in the body, which cutters are arranged to be fed laterally into counterboring position by actuating means having thrust engagement with the bottom of the hole. It will be understood that the body is rotated and fed forwardly by any suitable means, preferably by the usual jack rods employed in the preliminary drilling operations, and the forward feed in conjunction with the aforesaid thrust means forces the cutters into engagement with the sides of the hole to form a counterbore of the desired dimensions.

In one form of the invention the actuating means for the cutters comprises a centre piece or rod slidably mounted in the body and having a part engaged with the cutter adapted to effect an outward feeding movement thereof when the actuating means is moved rearwardly relatively to the body. The cutters may be provided with cam surfaces engaged by the actuating means for effecting the lateral feed.

According to a further feature of the invention, the cutters are pivotally mounted in the body, and preferably lie in slots which extend parallel to the axis of the tool. In one form of the invention each cutter is of flat cross-section and two cutters are mounted upon a common pivot pin. Each cutter is preferably formed with a cam slot. The slidable centre piece has a fork end carrying a cross pin which engages the two cam slots, which are formed so that as the fork moves rearwardly the cutters are fed outwardly into counterboring position.

In another form of the invention the cutters are actuated by a rack and pinion arrangement. In this form the body has a fixed centring piece for engaging the bottom of the hole and the rack members are mounted on a carrier which is movable relatively to the body; the rotary drive is transmitted to the carrier and thence through the rack members by engagement with the slots in which they slide. Each cutter comprises a flat plate-like element having a toothed sectoral portion near its end for engagement with the rack members. According to a feature of this construction, each rack lies alongside one of the cutters and forms a lateral guide when the cutter is extended outwardly.

According to a further feature of the invention, the cutters have shaped side faces adapted to engage the sides of the hole when displaced outwardly, and carry cutting diamonds in standard mountings.

According to a further feature of the invention the cutters are pivotally mounted and lie side by side within the body in withdrawn position, and means is provided to receive the lateral thrust on the cutters in their operative position. Such means may comprise thrust members extending partly into the slots in which

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the cutters are mounted, and may be fixed or movable. Thus in an arrangement in which the cutters are rack operated, the rack associated with one of the cutters is arranged to extend alongside the other cutter and to form a lateral abutment which is adapted to receive the side thrust on the cutter. The provision for taking up lateral thrust is important in that it permits the use of a relatively long cutter giving a wide lateral reach. The cutters lie snugly within the overall dimensions of the tool when withdrawn.

The invention may be embodied in various constructional forms, two of which will now be described by way of example. In carrying the invention into effect according to one convenient mode, there is provided a body or head of generally tubular form with flattened sides, adapted to be attached to a jack rod or like actuating means and rotated within the shot hole. Towards the rear end of the body a pair of diametrically disposed lateral slots are provided for accommodating the cutters. A transverse pivot pin mounted in the body towards the rear of the slots receives two cutters which are flat in cross-section and have shaped edges for engaging the sides of the hole. A recess in the lower end of each cutter engages a fixed pin which limits the cutter travel. The width of the cutter slots is twice the thickness of the individual cutters so that the latter may lie side by side in their withdrawn position. A guide member is welded in position to occupy half the width at the upper end of each slot and serves to take lateral thrust on the cutter when extended. It will be appreciated that the arrangement allows of the use of cutters of large cross-section since their width may be nearly equal to the diameter of the body. Each cutter has a cam slot inclined to the length of the cutter and this slot is engaged by an actuating pin to swing the cutter outwardly as the pin is moved rearwardly. Preferably the slot is slightly curved and also includes a straight portion parallel to the length of the cutter. The common pin which engages the oppositely inclined cam slots in the two cutters is carried by a fork sliding within the cylindrical bore of the body and is integral with a rod which at its forward end is attached to a centring member having a point which may be engaged with the bottom of the hole. The centring member is a hollow rod and accommodates a helical spring the rear end of which bears against a shoulder in the body, which should also form a guide for the forked rod. The spring tends to maintain the centring piece in its foremost position, the cutters being then withdrawn in the slots.

The cutters have shaped operative edges, including a curved portion which first engages the sides of the hole and straight portion inclined to the cutter axis. The edge is also slightly inclined with respect to the cutter axis and is drilled, to accommodate standard tapered diamond mountings.

The tool is attached to the usual jack rod or drilling rod and is introduced into the shot hole until the centre piece engages the bottom of the hole. Further forward movement of the tool will cause the cutters to be fed outwardly and the tool is then rotated to cut a counterbore. By continually feeding the tool forward the cutters will be displaced outwardly to their maximum extent, which will occur when the pin reaches the end of the inclined portion of the cam slot. Further forward feeding will bring the pin into the straight part of the cam and will cause parallel counterbore to be cut having a length corresponding to the length of said cam portion. It will be understood that by employing centre pieces of different length the position of the counterbore relative to the bottom of the hole may be varied. The tool is centrally bored and washing fluid may be supplied by the usual means.

In carrying the invention into effect according to another mode, the body of the tool carries the cutters at its forward end and the cutter feed is effected by a rack and pinion arrangement. In this form the tubular body has a forwardly extending and fixed centring piece, which however may be removable, permitting different lengths to be used. A pair of diametrically opposed lateral slots near the forward end of the body accommodate the two spaced cutters which as in the previous example are of flat cross-section. At the rear end of each cutter a toothed sector is formed, and the cutters are mounted on separate pivot pins which extend half way across the width of the slot. The rear end of the body has a large circular bore in which slides a carrier member which is adapted to be attached to the jack rod or drill rod. A pair of toothed racks extend forwardly from the front end of said carrier member and each engages the toothed sector of a cutter. These racks are adapted to slide forwardly and occupy one half of the cutter slots, and they also occupy the space between one side of the slots and the cutter pivot pins previously mentioned. Each slot thus accommodates a cutter and a rack side by side, and as the racks move forwardly they will lie alongside the cutters and provide

abutments for taking lateral thrust on the extended cutters. Retaining bridge members are welded across the rearward ends of the slots. The rack carrier is internally bored to accommodate a helical spring which bears against a shoulder within the body and lying just to the rear of the slots. This spring tends to maintain the carrier with the cutters in withdrawn position.

A stop member is mounted on the carrier and consists of a ring and a pair of arms which engage the rack shoulders when the blades are in the closed position. The ring is retained in place by a collar secured to the rear end of the body. It will be understood that rotation is applied to the carrier on which the racks are mounted and is transmitted to the body through the racks which are laterally engaged in the cutter slots as previously described. In use, the tool is advanced into the hole until the centre piece is engaged, after which further forward movement causes the carrier to be moved into the body against its spring and to actuate the cutters outwardly by means of the toothed racks. When the cutters are fully extended, further movement is prevented by the abutment of the rack carrier upon the shoulder of the body.

The cutters are in the form of blades of flat cross-section, having a pilot hole near one end and one side thereof, the toothed sector being of course concentric with the said hole. The cutting edge comprises a straight portion extending from near the pivot to the further end of the blade where it merges into a curved portion. The edge is drilled to receive diamond mountings.

The carrier member which is attached to the jack rod is centrally bored for admitting washing liquid and there is a continuation bore in the body terminating at the cutter slots.

It will be understood that the forms of counterboring tool described above are especially intended for enlarging the inner ends of the shot holes to enable bigger explosive charges to be employed in rock blasting. However, the invention may obviously be applied to many other uses where a counterbore or internal cutting operation is required. By making provision for the employment of centring pieces of varying lengths the counterbore may be made at any desired distance, within limits, from the end of the hole. The construction permits the supply of liquid from washing away the cuttings resulting from the operation of the tool.

Dated this 26th day of April, 1940.
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COMPLETE SPECIFICATION

Improvements in and relating to Rock Boring and like Tools

I, PERCY COX, a British Subject, of Old Bridleway, Forest Drive, Keston Park, Kent, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In rock blasting operations the size of the explosive charge is limited by the diameter of the shot hole which should be small, otherwise not only is the cost of drilling excessive but the efficacy of the charge will be reduced. The normal size of shot hole is from one and a half to three inches in diameter.

Proposals have been made to enlarge the inner ends of shot holes by counterboring for accommodating bigger charges and the present invention relates to rotary rock boring and like tools adapted for the counterboring of previously drilled holes in rock and similar formations either natural or artificial, of the type comprising a slotted body which may be introduced into the hole and rotated therein, having pivoted cutters mounted side by side in the slotted body and arranged to be fed laterally into counterboring position by actuating means having thrust engagement with the bottom of the hole.

The present invention aims at providing simple and effective improvements in a tool of the above type affording a rugged construction, in which the cutters are adapted to stand up to the lateral thrust developed in counterboring.

The invention consists in providing in a tool of the type described, guide and abutment means adapted to contact along a lower portion of the side of each cutter to afford support against lateral thrust on the cutters when in the extended position in counterboring.

In one form of the invention, the actuating means for the cutters comprises a centre piece or rod slidably mounted in the body and having a part engaged with cam slots in the cutters and adapted to effect an outward feeding movement thereof when the actuating means is moved rearwardly relatively to the body. For example, the cutters are of flat cross-section and are

mounted upon a common pivot pin in the slotted body of the tool. The cam slot of each cutter is slidably engaged by a cross-pin carried by a forked centre piece so that as the fork moves rearwardly the cutters are fed outwardly into counterboring position, the lateral thrust being taken by guide and abutment means or members extending into the slotted body of the tool.

In another form of the invention, the cutters are actuated by a rack and pinion arrangement. In this form, the body has a fixed centre piece for engaging the bottom of the hole, and the rack members are mounted on a carrier which is movable relatively to the body; the rotary drive is transmitted to the carrier and thence through the rack members by engagement with the slots in which they slide. Each cutter comprises a flat plate-like element having a toothed sectoral portion near its rear end for engagement with the rack members. In this case each rack extends alongside a cutter and forms lateral guide and thrust abutment means for the adjacent cutter when such is extended outwardly.

According to a further feature of the invention, the cutters have shaped side faces adapted to engage the sides of the hole when displaced outwardly, and preferably carry cutting diamonds in standard mountings.

Two suitable constructional forms of the invention will now be described by way of example and illustrated by the accompanying drawings, in which:—

Figure 1 is an elevation of a rock counterboring tool according to the present invention;

Figure 2 is an elevation of the tool taken in a plane at right-angles to the plane of Figure 1, showing the cutters removed;

Figure 3 is a cross-section of the tool, with the cutters removed, taken on the line 3—3 of Figure 1;

Figure 4 is an end view of the forward end of the tool;

Figure 5 is an elevation of the sliding fork for actuating the cutters;

Figure 6 is a side view of one of the cutters;

Figure 6a is an end view of the cutter;

Figure 7 is an elevation of another form of rock counterboring tool;

Figure 8 is an elevation of the body of the tool taken on a plane at right-angles to the plane of Figure 7;

Figure 9 is an end view of the body of the tool taken from the rear;

Figure 10 is a cross-section taken on the line 10—10 of Figure 7;

Figure 11 is a cross-section taken on the line 11—11 of Figure 7;

Figure 12 is an elevation of the carrier member for the toothed racks;

Figure 13 is an end view of the carrier member;

Figure 14 is an elevation of the stop-member for the carrier member;

Figures 15 and 16 are side and end views respectively of one of the cutters; and

Figure 17 is an end view of a part of one of the cutters showing the method of mounting the diamonds.

In carrying the invention into effect according to one convenient mode as illustrated in Figures 1 to 6, the rock counterboring tool is provided with a body or head 1 of generally tubular form having flattened sides and adapted to be attached at 2 to a jack rod or like actuating means such as are generally used with rock drills for rotating the tool within the hole. Towards the rear end of the body a pair of diametrically disposed lateral slots 3 are provided for accommodating the cutters. A transverse pivot pin 4 mounted in the body towards the rear of the slots 3 receives two cutters 5 which are flat in cross-section and have shaped edges 6 for engaging the sides of the hole. A recess 7 in the lower end of each cutter engages a fixed pin 8 mounted in the body 1 which limits the lateral or outward swinging movement of the cutter. The width of the cutter slots 3 is slightly in excess of twice the thickness of the individual cutters 5 so that the latter may lie side by side when in their withdrawn position. A guide member 9 consisting of a rectangular plate is welded in position to occupy half the width towards the upper end of each slot 3, and serves to take lateral thrust exerted on the cutter when the latter is in an extended position and in cutting engagement with the sides of the hole. It will be appreciated that this arrangement allows of the use of cutters of relatively large cross-section as compared with the diameter of the body of the tool, since their width may be nearly equal to the latter. In their withdrawn position the cutters lie wholly within the body of the tool as shown in dotted lines in Figure 1.

Each cutter is provided with a cam slot 10 inclined to the general length of the cutter, and this slot is adapted to be engaged by an actuating pin to swing the cutter outwardly upon its pivot 4 as the actuating pin is moved rearwardly. The slot 10 is preferably slightly curved as shown and also includes a straight portion 11. A recess 12 provided on one edge of each cutter is adapted to fit over the thrust receiving member 9 when the cutter is in its completely withdrawn position.

The common actuating pin 13 which

engages the oppositely inclined slots in the two cutters is carried by a fork 14 sliding within the cylindrical bore 15 of the body and is integral with a rod 16 which at its forward end is attached to a centre piece 17 having a point 18 which is adapted to be engaged with the bottom of the shot hole. This centre piece is formed with a flat 19 on one side slidably engaged by a pin 20 which prevents rotation. A cylindrical bore 21 within the centre piece 17 accommodates a helical spring 22, the rear end of which bears against a shoulder 23 in the body, this shoulder also forming a guide for the rod 16. The spring 22 tends to maintain the centre piece 17 in its foremost position, in which also the cutters are completely withdrawn within the slots 3.

The cutters have shaped operative cutting edges as shown in Figure 6, including a curved portion which first engages the sides of the hole and a straight portion which is inclined to the general direction of the length of the cutter. The edge 6 is also slightly inclined with respect to the pivotal axis of the cutter and is drilled to accommodate standard tapered diamond mountings as indicated at 24.

The tool is attached at 2 to the usual jack rod or drilling rod and is introduced into the shot hole until the point of the centre piece is engaged with the bottom of the hole. Further forward movement of the tool will cause the cutters to be fed outwardly until their operative edges 6 engage the side of the hole and the tool is then rotated to cut a counterbore. By continuously exerting a forward feeding pressure on the tool the cutters will be progressively displaced outwardly to their maximum extent, which will occur when the actuating pin 13 reaches the end of the curved portion of the cam slot 10. Further forward feeding movement will bring the pin 18 into the straight part 11 of the cam slot and movement of the pin along this slot portion will not result in any further outward displacement of the cutters. In this way a parallel-sided counterbore will be cut having a length corresponding to the length of the straight portion 11 of the cam slot. It will be understood that by employing centre pieces 17 of different lengths, the position of the counterbore relative to the bottom of the hole may be varied. It will be noted that the tool has a central bore which extends into the cutter slots and washing liquid may be supplied by this means.

In carrying the invention into effect according to another mode, as illustrated in Figures 7 to 17, the cutters are arranged to be carried at the forward end of the body of the tool and the cutter feed is effected by means of a rack and pinion arrangement. In this form the tubular body 25 has a forwardly extending centre piece 26 secured therein. This centre piece may however be removable, permitting centre pieces of different lengths to be used. A pair of diametrically opposed lateral slots 27 are provided near the forward end of the body 25 and are adapted to accommodate two opposed cutters 28 which as in the previous example are of flat cross-section as shown in Figures 15 and 16. Each cutter is provided with an operative cutting face which is partly straight as at 45 and partly curved as at 47, and at its rear end is formed with a toothed sector 29. The cutters are mounted on separate pivot pins 30, each of which extends half-way across the width of the respective cutter slot 27.

The rear end of the body 25 has a large circular bore 31 in which slides a carrier member 32, the end 33 of which is adapted to be attached to the jack rod or drill rod. A pair of toothed racks 34 extend forwardly from the front end of the carrier member 32 and each engages with the toothed sector 29 of a cutter. These racks are adapted to slide to and fro and occupy one half of the cutter slots, and they are also adapted to occupy the space between one side of the said slots and the cutter pivot pins 30 as shown in Figure 10. A shoulder 35 having a bore 36 is provided at the forward end of the cylindrical bore 31. Each slot thus accommodates a cutter and a rack side by side and as the racks are moved forwardly they will lie alongside the cutters and provide abutments for taking the lateral thrust caused by the engagement of the extended cutters with the side of the hole. Retaining bridge members 37 are welded across the rearward ends of the slots 27. The rack carrier member 32 is provided with a large internal bore 38 in communication with a small bore 39 through which washing fluid may be supplied. The enlarged bore 38 accommodates a helical spring 40 which bears against the shoulder 35. The action of this spring tends to maintain the carrier member 32 in a position in which the shutters are withdrawn within their slots, as indicated in Figure 7.

A stop member is mounted on the body of the tool and consists of a ring 41 formed integrally with a pair of arms 42 which pass through slots 42a in the body and engage the shoulders 34a of the racks 34 when the blades of the cutters are in their withdrawn or closed position. The ring 41 is retained in place by means of a collar 43 secured to the rear end of the body 25. It will be understood that rota-

tion is applied to the carrier 32 on which the racks 34 are mounted and is transmitted to the body 25 through the racks which are laterally engaged in the cutter slots as previously described. In use, the tool is advanced into the hole until the centre piece 26 is engaged with the end thereof, after which further forward movement causes the carrier member 32 to be moved into the body against the action of the spring 40 and actuates the cutters 28 outwardly by means of the toothed racks 34 engaging with the toothed sectors 29. When the cutters have been fully extended further movement is prevented by the abutment of the forward end of the carrier member 32 against the shoulder 35 within the body.

The cutters are in the form of blades 44 of flat cross-section having a pivot hole 45 near one end and one side thereof, the toothed sector 29 being concentric with the said hole. The cutting edge comprises a straight portion 46 extending from near the pivot 45 to the further end of the blade where it merges into a curved portion 47. The edge is drilled transversely as indicated at 48 and receives standard tapered diamond mountings 49.

As previously mentioned, the carrier member 32 is centrally bored for admitting washing liquid, and there is a continuation bore in the body 25 through which the liquid is supplied to the cutter slots.

It will be understood that the forms of counterboring tool described above are especially intended for enlarging the inner ends of shot holes to enable bigger explosive charges to be employed in rock blasting. However, the invention may obviously be applied to many other uses where a counterbore or internal cutting operation is required. By making provision for the employment of centre pieces of varying lengths, the counterbore may be made at any desired distance, within limits, from the end of the hole. The construction permits of the supply of liquid for washing away the cuttings resulting from the operation of the tool.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A counterboring tool of the type described and having guide and abutment means adapted to contact along a lower portion of the side of each cutter to afford support against lateral thrust on the cutters when in the extended position in counterboring.

2. A tool as claimed in Claim 1 in which the cutters are flat in cross-section with cam slots therein adapted to be engaged by actuating means comprising a part on a centre piece or rod slidably mounted in the body.

3. A tool as claimed in Claim 1 or 2, in which the cutters are mounted upon a common pivot.

4. A tool as claimed in Claim 2, in which the slidable centre piece has a fork end carrying a cross pin engaging the cam slots of the cutters.

5. A tool as claimed in Claim 1, in which the cutters are actuated by a rack and pinion arrangement.

6. A tool as claimed in Claim 5, in which the body has a fixed centre piece for engaging the bottom of the hole and rack members mounted on a carrier which is movable relatively to the body engage toothed sectors on the cutters.

7. A tool as claimed in Claim 6, in which the rotary drive is transmitted to the carrier member and thence through the rack members by engagement with the slots in which they slide.

8. A tool as claimed in Claim 5, 6 or 7, in which each cutter comprises a flat blade-like element having a toothed sectoral portion near its rear end for engagement with the rack members.

9. A tool as claimed in Claim 5, 6, 7 or 8, in which each rack member lies alongside one of the cutters and forms a lateral guide and thrust abutment therefor when the cutter is extended outwardly.

10. A tool as claimed in any of the preceding claims in which the cutters have shaped side faces adapted to engage the sides of the hole when displaced outwardly and carry cutting diamonds in standard mountings.

11. The improved form of counterboring tool substantially as hereinbefore described with reference to Figures 1—6 of the accompanying drawings.

12. The improved form of counterboring tool substantially as described with reference to Figures 7—17 of the accompanying drawings.

Dated this 17th day of April, 1941.

MARKS & CLERK.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1941.

[This Drawing is a reproduction of the Original on a reduced scale.]

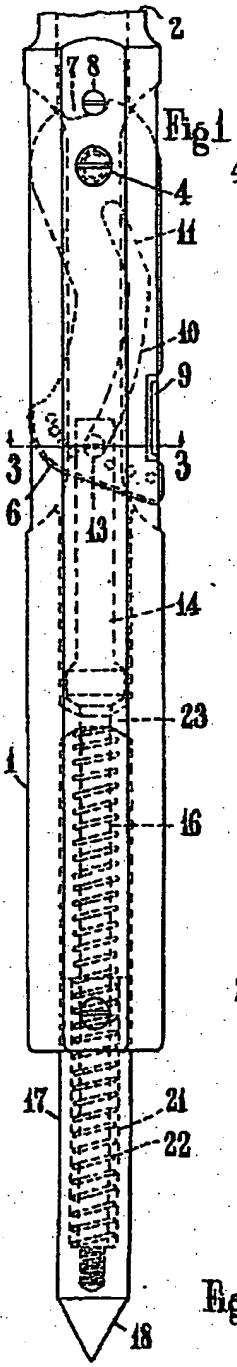


Fig 1

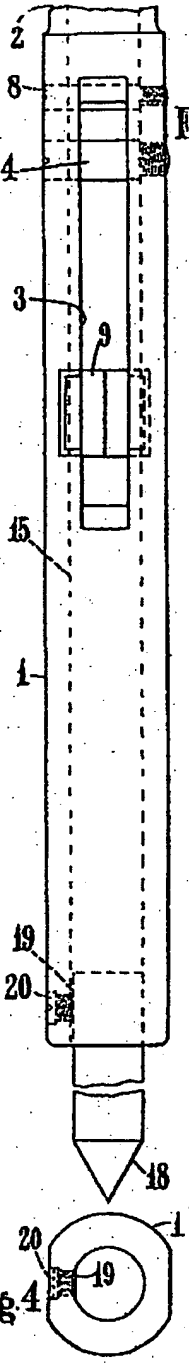


Fig 2.

Fig 4

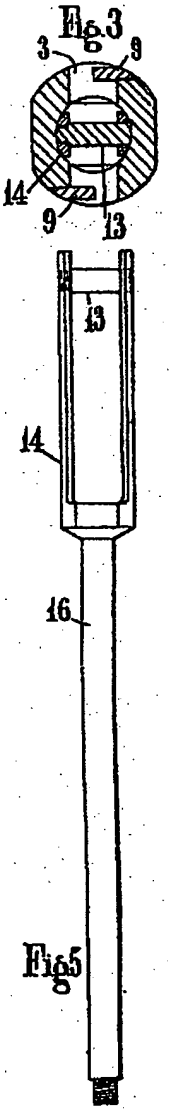


Fig 3

Fig 5

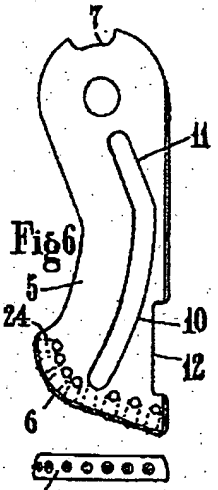


Fig 6

Fig 6a

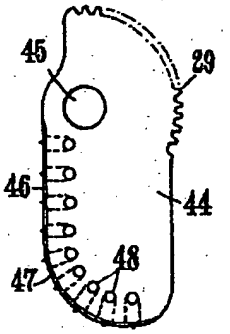


Fig 15

Fig 16

Fig 17

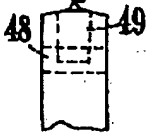


Fig 7

2 SHEETS

SHEET 2

SHEET 1

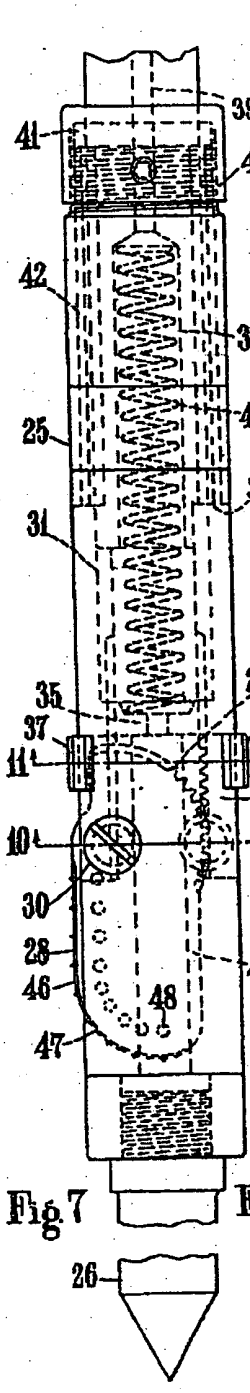


Fig.7

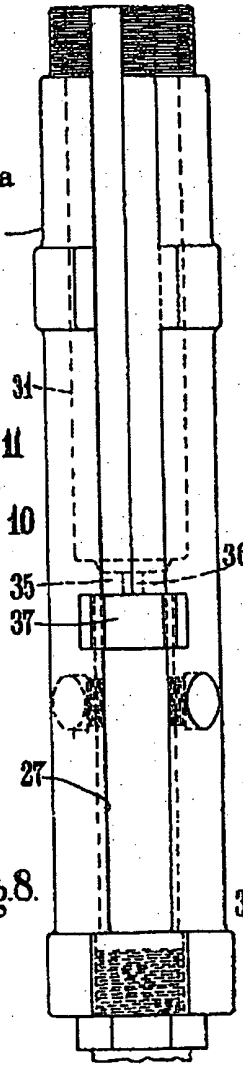


Fig.8.

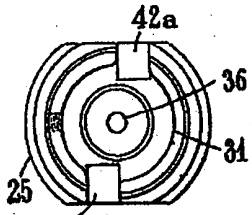


Fig.9

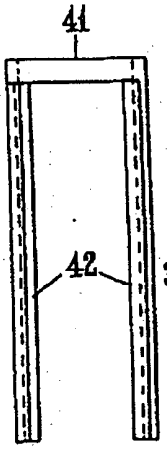


Fig.14

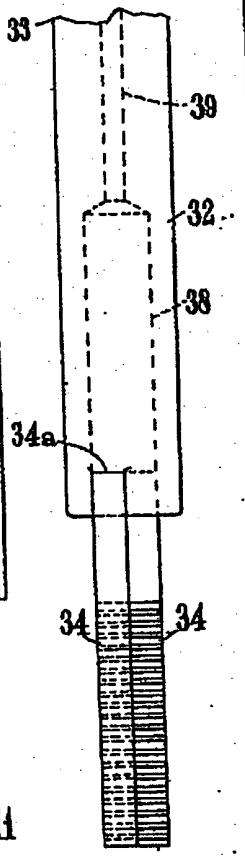


Fig.12

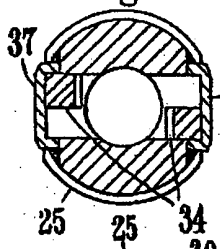


Fig.11

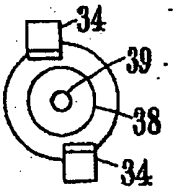


Fig.13

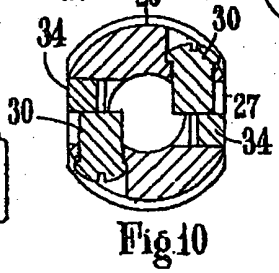
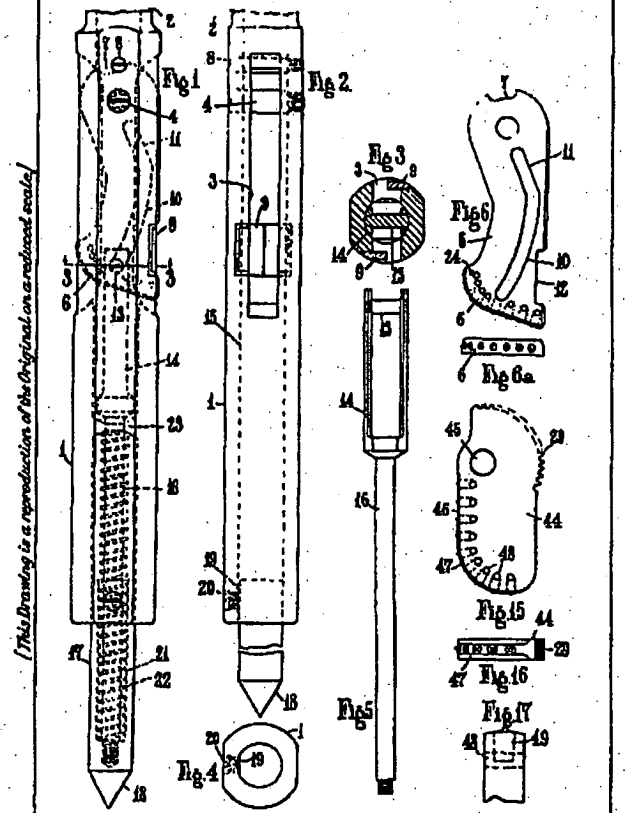
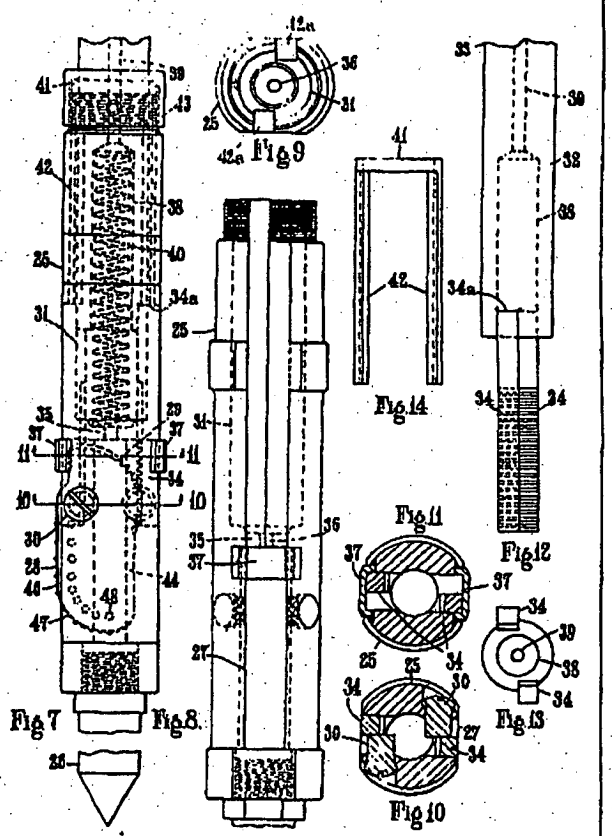


Fig.10

Malby & Sons, Photo-Lith.

840,027 COMPLETE SPECIFICATION





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